FLEXIBLE DISPLAY DEVICES

[0001] This application is a continuation of U.S. patent application Ser. No. 15/270,936, filed Sep. 20, 2016, which is a continuation of U.S. patent application Ser. No. 14/335,783, filed Jul. 18, 2014, now U.S. Pat. No. 9,504,170, which is a divisional of U.S. patent application Ser. No. 13/177,165, filed Jul. 6, 2011, now U.S. Pat. No. 8,787,016, all of which are hereby incorporated by reference herein in their entireties.

BACKGROUND

[0002] This relates generally to electronic devices, and, more particularly, to electronic devices with flexible displays.

[0003] Electronic devices such as cellular telephones, media players, and computers are often provided with displays. For example, electronic devices may be provided with liquid crystal displays. Liquid crystal displays are often mounted under a rigid layer of cover glass. The cover glass protects the liquid crystal display from damage, but the rigid nature of the cover glass and other display layers render the display inflexible.

[0004] Flexible display technologies are available that allow displays to be bent. For example, flexible displays may be formed using flexible organic light-emitting diode (OLED) display technology.

[0005] It would be desirable to be able to use flexible display technology to provide improved electronic devices.

SUMMARY

[0006] Electronic devices may be provided that contain multiple housing portions. The housing portions may include, for example, first and second rectangular housing portions.

[0007] The housing portions may be coupled together using hinges. The hinges may include hinges based on a three-bar linkage, hinges based on a four-bar linkage, hinges with slotted members, hinges formed from flexible support structures, and hinges based on flexible housing structures.

[0008] Flexible displays may be mounted to the housing portions overlapping the hinges. When the housing portions in a device are rotated relative to each other, the flexible display may bend. Hinges may be configured to allow the flexible display to be placed in a front-to-front configuration in which the active side of the display faces itself or a back-to-back configuration in which the active portions of the display face away from each other. To avoid stretching the display, the display may be tensioned with tensioning structures and dispensed from a roller or an opening in a housing structure.

[0009] Engagement structures may be used to help the housing grip external objects and to hold the housing portions in desired positions. The hinges may also be provided with rotational detents to help hold the flexible display in desired positions.

[0010] Further features of the invention, its nature and various advantages will be more apparent from the accompanying drawings and the following detailed description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. **1** is a perspective view of an illustrative electronic device with a flexible display in accordance with an embodiment of the present invention.

[0012] FIG. **2** is a side view of an illustrative electronic device with a flexible display and a hinge formed using a three-bar linkage arrangement in which the flexible display has been placed in a planar configuration in accordance with an embodiment of the present invention.

[0013] FIG. **3** is a side view of an illustrative electronic device with a flexible display and a hinge formed using a three-bar linkage arrangement in which the flexible display has been placed in a face-to-face configuration in accordance with an embodiment of the present invention.

[0014] FIG. **4** is a side view of an illustrative electronic device with a flexible display and a hinge formed using a three-bar linkage arrangement in which the flexible display has been placed in a back-to-back configuration in accordance with an embodiment of the present invention.

[0015] FIG. **5** is a side view of an illustrative electronic device having a tensioning structure and a roller for controlling the dispensing and retracting of a flexible display in accordance with an embodiment of the present invention.

[0016] FIG. **6** is a side view of an illustrative electronic device having a tensioning structure and a housing structure protrusion with an opening to accommodate deployment and retraction of a tensioned flexible display in accordance with an embodiment of the present invention.

[0017] FIG. **7** is a cross-sectional side view of an illustrative electronic device in which a housing has been provided with overhanging portions along its edges that serve to hold a flexible display in place on the planar surface of the housing while the flexible display slides along the surface of the display during deployment and retraction operations in accordance with an embodiment of the present invention.

[0018] FIG. **8** is a top view of an electronic device having a housing with overlapping edge portions that guide and hold a flexible display as the flexible display slides relative to the housing in accordance with an embodiment of the present invention.

[0019] FIG. **9** is a side view of an illustrative electronic device with a flexible display that has first and second housing portions that have been rotated relative to each other to place the electronic device housing into a triangular configuration in accordance with an embodiment of the present invention.

[0020] FIG. **10** is a side view of an illustrative electronic device with a flexible display having a hinge that is based on a four-bar linkage in accordance with an embodiment of the present invention.

[0021] FIG. **11** is a side view of an illustrative electronic device of the type shown in FIG. **10** that has a flexible display and a hinge that is based on a four-bar linkage in which the device housing has been manipulated to place the display in a back-to-back configuration in accordance with an embodiment of the present invention.

[0022] FIG. **12** is a side view of an illustrative electronic device having a flexible display mounted on two housing portions that are coupled using a hinge with first and second slots that receive sliding shafts attached to the housing portions in accordance with an embodiment of the present invention.